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ABSTRACT

Twenty-one studies related to populations are included in this student manual for a junior high school biology course. Each activity or study provides questions, diagrams, experiments, and/or descriptive material to which the student must respond. Population studies pertain to individual plants and animals, their physical environments, reactions between species, and their interrelationships. (BL)

JUNIOR BIOLOGY

ED0 46781

POPULATIONS

SE 010 745

The Board of Education for the City of Hamilton

100 MAIN STREET WEST
HAMILTON, ONT.

JUNIOR BIOLOGY

B. P O P U L A T I O N S

1. SUPPLEMENTAL ACTIVITIES

B. POPULATIONS

A. SUPPLEMENTAL ACTIVITIES

Activity 1: Individuals, Populations, Communities and Ecosystems
2: An Example of Population Fluctuation
3: Population Problems
4: Reactions Between Species
5: Population Problems & Graphs I
6: Population Problems & Graphs II
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18: Determiners of Population Density
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B. 16 MM. FILMS

C. FILMSTRIPS

ACTIVITY 1: INDIVIDUALS, POPULATIONS, COMMUNITIES & ECOSYSTEMS

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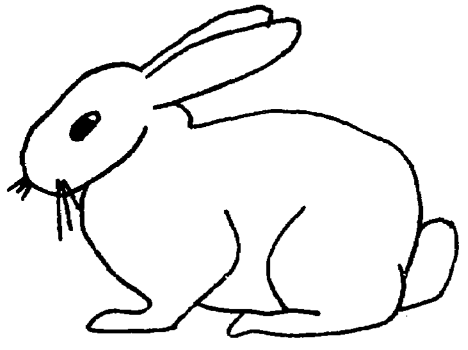
WHAT IS AN INDIVIDUAL?

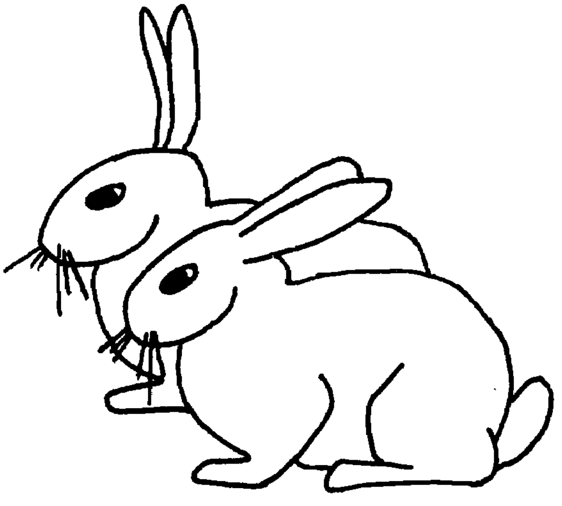


On this, and the following pages, are a number of drawings of organisms.

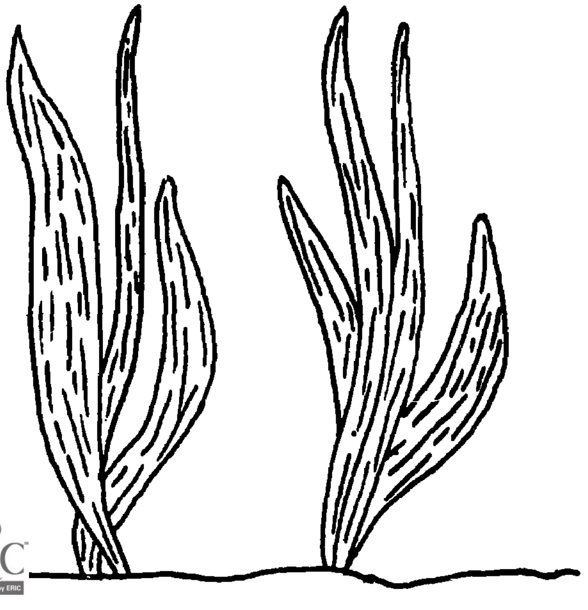
In some of the drawings, a single organism (an individual) is shown. In others, there may be a group of individuals. You are asked to decide if there is one, or many.

This organism is called a ______________

The number of individuals shown is ◯

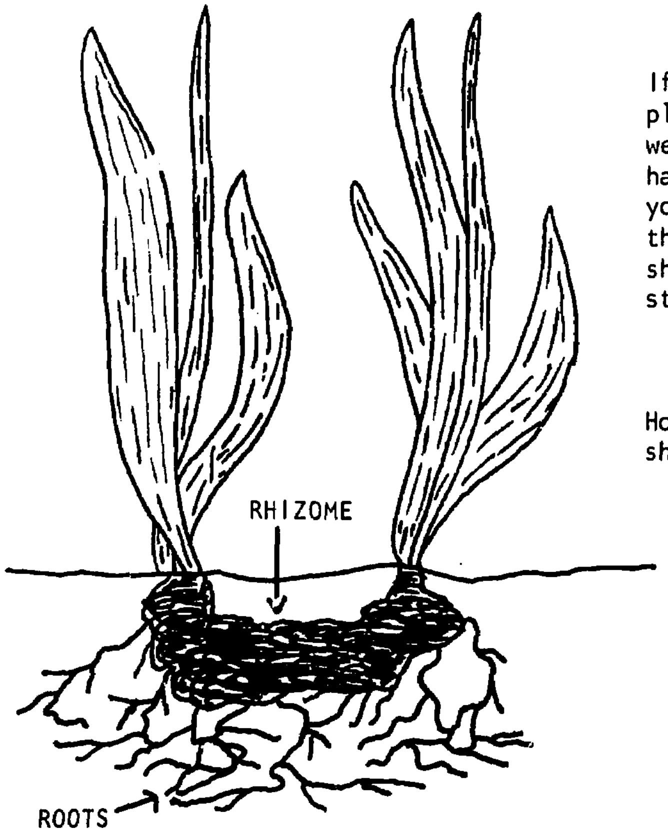


Clearly, you can recognize that this drawing shows ◯ ______________



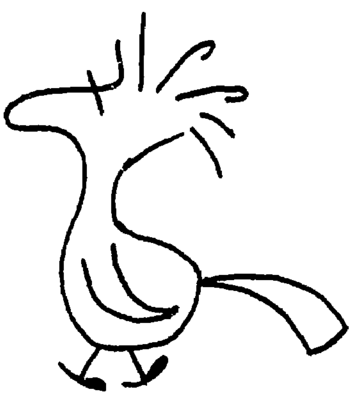
This is a drawing of a common garden plant; the IRIS.

How many iris plants are shown in the drawing? ◯

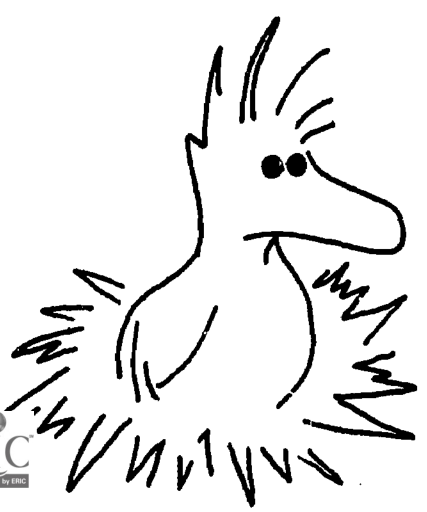


If you stated that there were two iris plants shown at the bottom of Page , you were correct as far as the data that you had available was concerned. However, if you dug the earth away from the base of the leaves, you might find that the two shoots were connected by an underground stem called a rhizome.

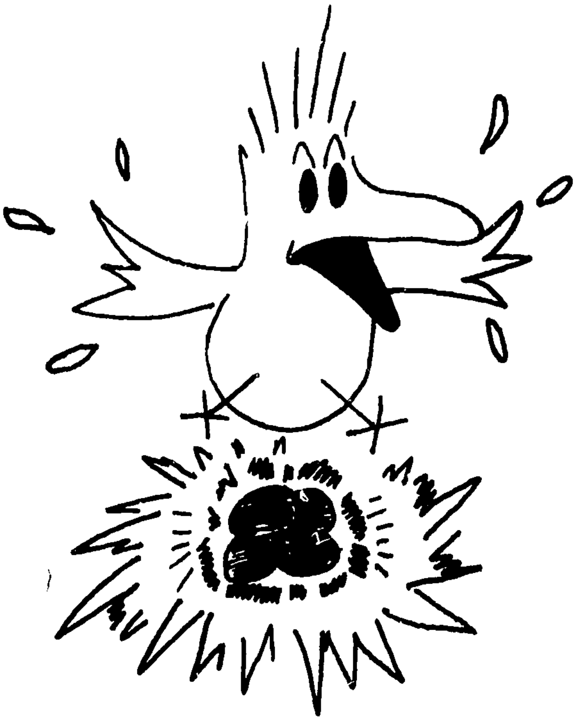
How many individuals would you say are shown in this drawing?



This is Snoopy's fine-feathered friend. Let's just call it a bird: a female bird. She is on her way back to the nest after a game of cards at Snoopy's house.



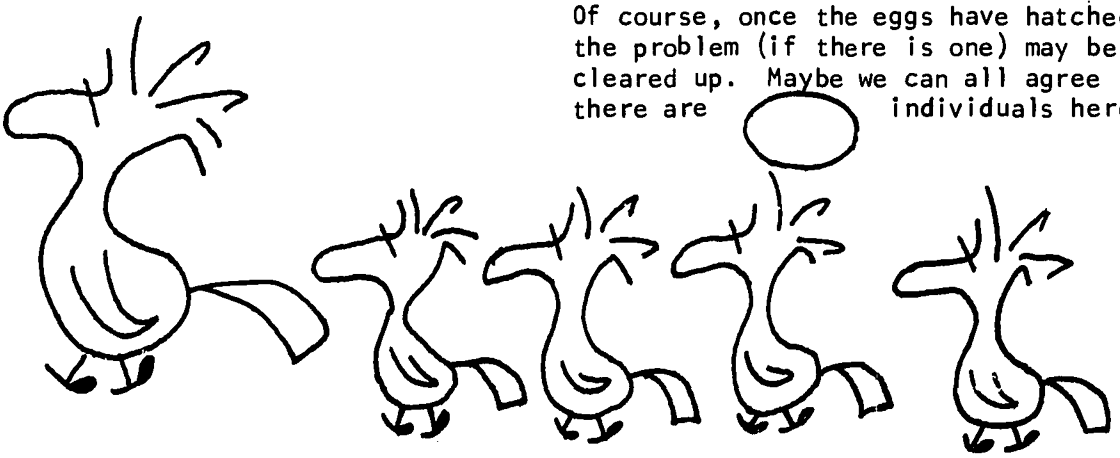
How many individuals are there here?



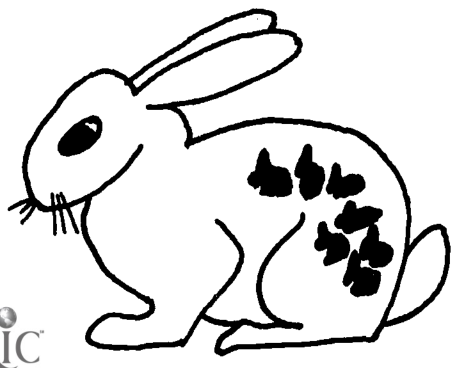
Hold it! Maybe there is something else that you should know in order to correctly answer the question at the bottom of Page .

How many individuals are there?

Explain why your answer is the same or different.

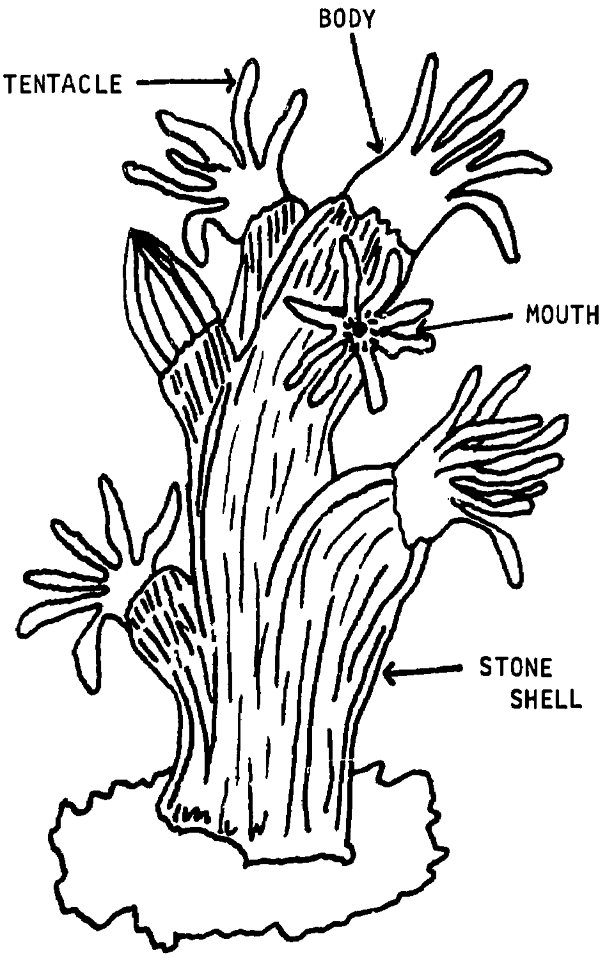


Of course, once the eggs have hatched, the problem (if there is one) may be cleared up. Maybe we can all agree that there are individuals here.



Let's take a closer look at the rabbit that we started with. Suppose that it is a female rabbit with seven unborn young. How many individuals are there in the drawing?

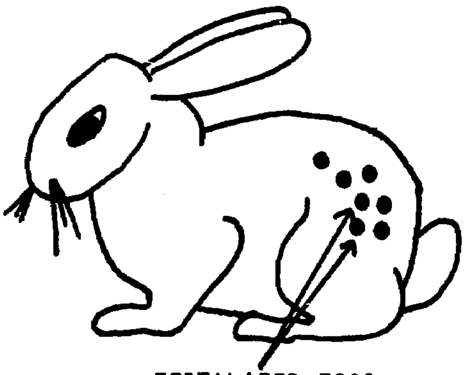
What is your reason for saying this?



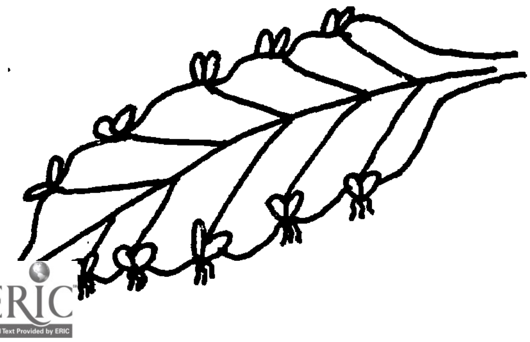
This is a drawing of coral. How many individuals are there in the drawing?

The commonest numbers that people pick are 1 or 6. Coral holds the same trick as the iris at the bottom of Page . Each of the bodies is connected. Does this make a difference? How many individuals are there here?

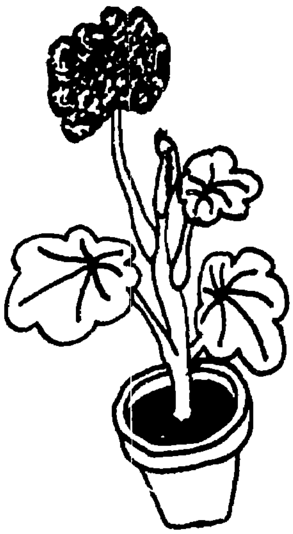
Actually, many biologists would disagree as to how many corals we have here. If one of the bodies becomes separated from the rest, it can survive on its own, and begin a new coral colony. How many corals are there here?



If we go back to the rabbit and consider the unborn babies again, we have to admit that they started out as fertilized eggs (ie. eggs that have joined with the male sperm). If we were to consider the rabbit right now, how many individuals would you say there are?



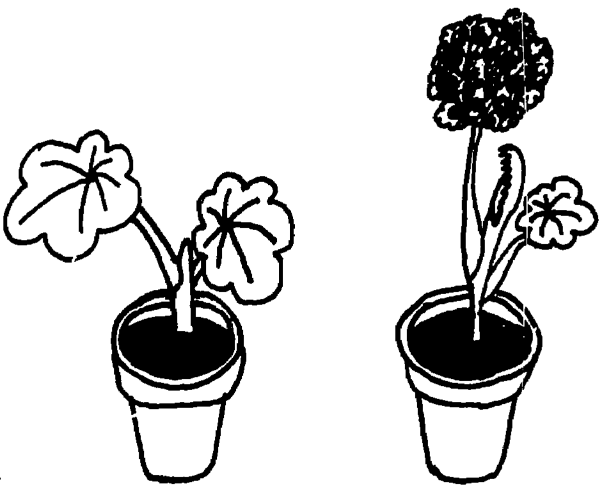
This drawing shows a leaf from a plant called BRYOPHYLLUM. The leaves of this plant can start new plants along the margin of the leaf. When the baby plants are big enough to live on their own, they drop off and take root. How many plants?



So far, we have considered plants and some animals that are able to have a small part of themselves break away and become new individuals. Other organisms can do this too, but they may need some help.

This is a drawing of a geranium plant.

How many geraniums are there in this drawing?

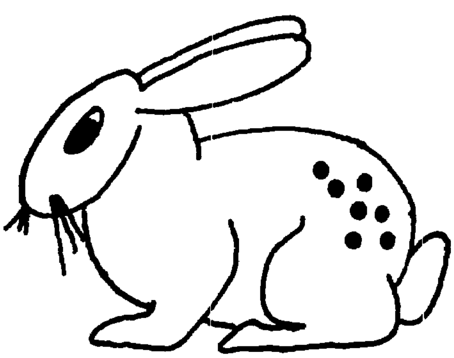


If the tops of geranium plants are cut off and stuck in the ground, some of the tops keep growing by producing roots to become a new plant.

How many geraniums are there here?

If your answer here is two, would you like to change the answer at the top?

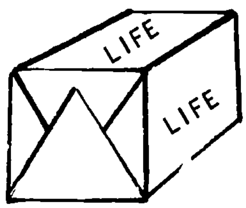
Give a reason of two to justify your answers.



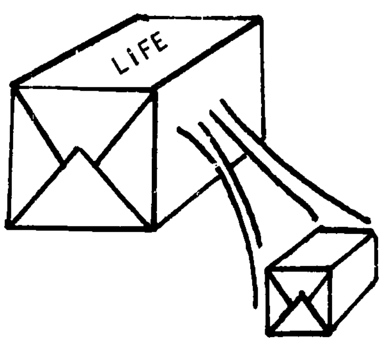
Meanwhile, back at the rabbit, those fertilized eggs we were thinking about must have once been unfertilized eggs before they united with the sperms. This drawing shows a female rabbit with unfertilized eggs. How many individuals are there here?

Explain your answer:

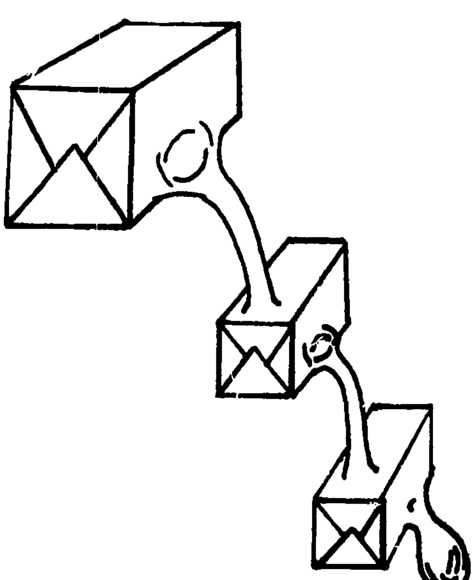
By now, if you haven't cheated and read this first, you are probably a little confused as to what is, and what is not, an individual.



Let's look at the problem this way. When you look around you, you can see lots of living things. These living things, for the most part, exist as separate packages of life. Each package of life can donate a small part of itself for the purpose of making a new package of life. In the case of the rabbit, the female donates a part of herself (the egg) and the male, a part of himself (the sperm).



Outwardly, we are not aware that there is more than one individual present until a short time before the new rabbits are born. That is, we cannot decide about individualness until we are sure about the new packages of life (the babies).



Life is continuous and, at first, the new individual is connected to the old. Usually this physical connection is broken at birth, but sometimes the connection is not clearly broken, and the result is often a bit confusing. Such cases as the iris and the coral and the bryophyllum and even the geranium are examples of this lack of a clean break unless there is human intervention. Also, if we are willing to wait long enough, the break will occur (bryophyllum and geranium). At other times, the break might never come and one part of a life package may start a new one even while it is still connected to the one that started it.

In many cases, then, there is no confusion, and clearly you are dealing with a specific number of individuals. Only in special cases does it become a matter of timing; that is, it is a question of WHEN a new individual has come into existence.

The time when a new individual has been created has no absolute answer. The biologist may have one idea, a doctor another, the church still another, and the state (the government) another yet. Therefore, you cannot fit all this into a neat little definition. Instead, you must learn to judge each case on the data you can obtain; you must be aware of the problem itself, and you must keep an open mind to change your answer if new data indicates that a change is needed.

In the space below, list some of the facts that you need in order to decide whether you are dealing with one, or a number of individuals.

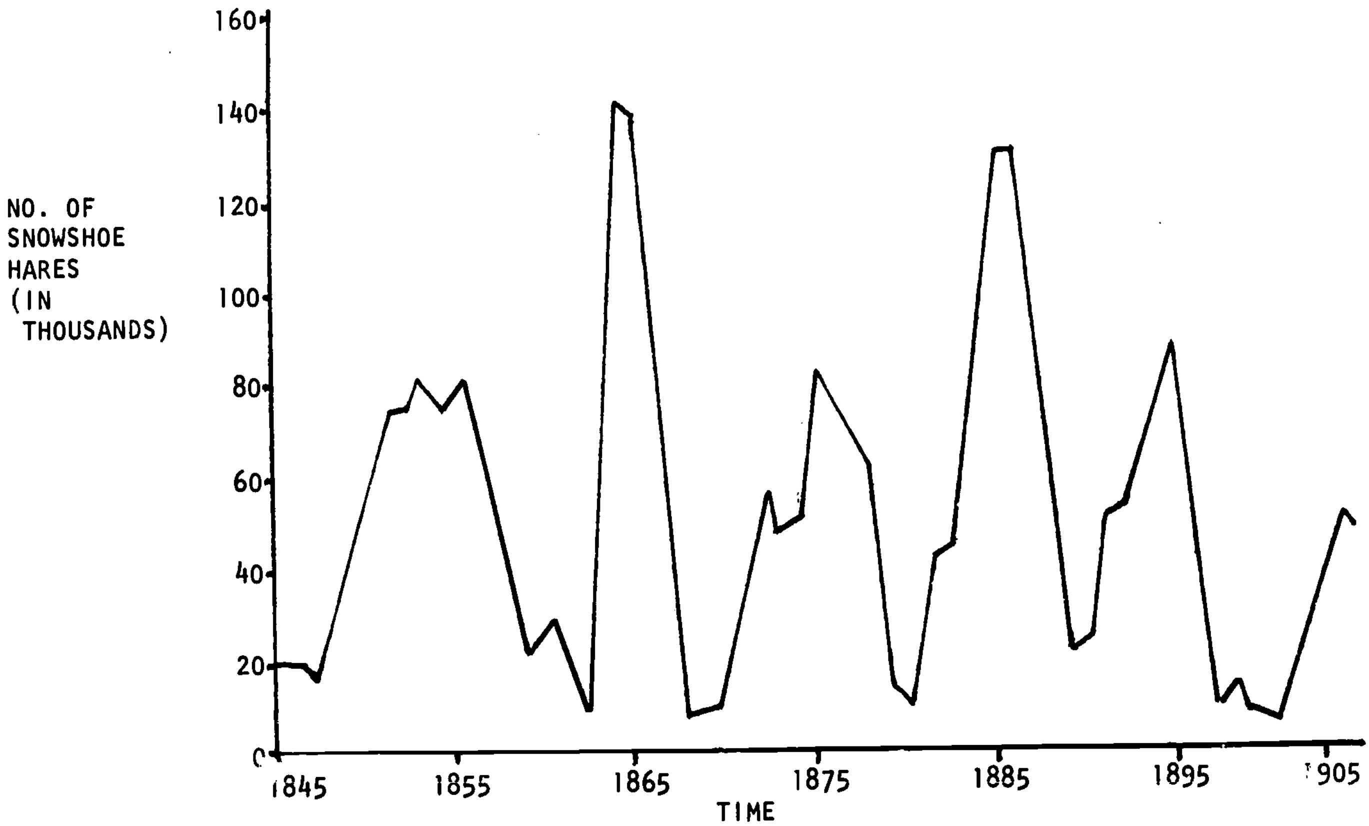
<u>REMEMBER</u>: <u>Life is continuous in time</u>.

That is, life comes from life and there is an unbroken chain of life units from the beginning to the very end of all time.

<u>Life exists as separate packages in time and in space</u>.

ACTIVITY 2: AN EXAMPLE OF POPULATION FLUCTUATION

The following is a graph of changes in the snowshoe hare population, as indicated by the number of pelts received by the Hudson's Bay Company.



1. Explain why the snowshoe hare population fluctuates the way that it does.

2. Plot the following information on the graph above:

Year	No. of Lynx (in thousands)
1845	30
1847	50
1851	7
1855	35
1860	3
1867	70
1871	4
1874	35
1876	48
1880	11
1881	11
1885	80
1887	45
1891	12

3. What term would you use to describe the lynx population graph?

4. How do the fluctuations in the snowshoe hare population compare with the fluctuations in the lynx population?

5. Do you think what you have noted in Question 4 is a coincidence? If you think that it is a coincidence, what do you think lynx eat for breakfast?

6. What would you now say caused the decrease in the snowshoe hare population to occur?

7. What happens to the supply of food for the lynx population when the snowshoe hare population decreases?

8. How would this affect the lynx population?

9. With fewer lynx to eat the snowshoe hare, what would happen to the snowshoe hare population?

10. If the number of lynx breakfasts increased, what would happen to the number of lynx?

The above is a classic example of a predator-prey relationship. This study also illustrates a "balance of nature" often referred to as steady state by biologists.

ACTIVITY 3: POPULATION PROBLEMS

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1. A particular species of green algae, when grown in the laboratory, has a natality rate of 30% per hour, and reproduces asexually. If the original colony consisted of 100 individuals, plot the graph showing the population sizes for ten continuous hours. Assume that there was adequate nutrients to keep the mortality at 0%.

2. In the chart below are population figures for Cottontail rabbits in a northern woods.

January.........	88 rabbits
February........	82 rabbits
March...........	73 rabbits
April..........	284 rabbits
May............	264 rabbits
June...........	224 rabbits
July...........	208 rabbits
August.........	824 rabbits
September......	809 rabbits
October........	792 rabbits
November.......	776 rabbits
December.......	748 rabbits

Plot the above figures on a graph.

How often do rabbits breed?
Do you have any evidence?

<u>Calculate</u>: the average monthly mortality rate.
the average natality rate.

3. A maple tree, standing alone in a field, under ideal conditions will produce, on the average, 15,000 seeds.

Under ideal conditions, what is the natality rate? If the mortality rate for maple seeds is 95%, how many trees would you expect?

4. A biological population of a particular species of soil microbes cannot survive if the mortality rate exceeds 47%. An original colony of 23,864 individuals was found to contain 12,644 corpses. Was the colony dying or not?

ACTIVITY 4: REACTIONS BETWEEN SPECIES

1. What is meant by the statement "No organism lives alone"?

2. "A predator is a factor in determining the population density of a species it eats, but a saprovore is not." Explain.

3. Why is it impossible to draw sharp boundaries between communities?

4. How can organisms living in the same place be said to occupy different niches?

5. What are some ways in which man has changed ecosystems?

ACTIVITY 5: POPULATION PROBLEMS & GRAPHS I

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1. This study concerns a population of field mice, over a period of 10 days. On the horizontal axis, select equal divisions and number them from 0 to 10, so that this scale covers most of the open space. DON'T CROWD THE NUMBERS TOGETHER. On the vertical axis, you will be putting the number of mice. Select a value for the squares on the graph which will allow you to spread out values as much as possible

Day	Number of Mice
0	15
1	15
2	21
3	24
4	23
5	23
6	22
7	14
8	14
9	13
10	9

(a) With the above information, prepare a complete, neat graph.

(b) Give two possible reasons for the change which is shown on the second day.

(c) Give two possible reasons for the change which is shown on the seventh day.

2. This study concerns a small town population. For this one, plot the date in years along the horizontal axis. Plot the population of people on the vertical axis. You must calculate the figures from the information given below.

Year	Births	Deaths	Newcomers	Moved Away
1945	This was the year of the Census: Population was 85			
1946	4	1	8	12
1947	3	5	4	9
1948	5	4	6	7
1949	2	6	6	4
1950	4	2	5	3
1951	6	4	5	7
1952	3	8	2	5
1953	0	2	4	2
1954	1	3	2	0

(a) Calculate the population for the small town for each of the years.

(b) Plot the information on the graph.

(c) Was the population of the town increasing or decreasing?

(d) With the same information, plot the graph, this time with the population on the horizontal axis, and the date on the vertical axis.

(e) Which of the two graphs is easier to read and understand? Why?

ACTIVITY 6: POPULATION PROBLEMS & GRAPHS II

1. Refer back to the dittoed sheet on which you calculated populations of box turtles (or see H.S.B., Page 70, Question No. 1). Plot the information on Total Populations on a graph, Years on the horizontal axis, Number of Turtles on the vertical axis.

2. On this graph, you are to draw <u>two separate</u> population curves, for grey mice and brown mice living in a barn. Plot Time on the horizontal axis, Number of Mice on the vertical axis. Use the same scales for both. Plot one curve first, and then the other one, in a different colour. Label each line.

Month	No. of Grey Mice	No. of Brown Mice
January	28	11
February	30	10
March	24	19
April	23	20
May	18	18
June	25	25
July	21	24
August	18	21
September	15	28
October	11	30
November	9	28
December	9	32

ACTIVITY 7: QUESTIONS

1. In a certain city an eight block area contained 1,056 human beings and an estimated population of 1,400 rats. Then an Urban Renewal Commission razed the wooden buildings on the area and constructed eight large apartment houses. Following this action, the area was occupied by 2,480 human beings and an estimated population of 150 rats. Calculate the change in population density of both organisms. What determiners probably were predominant in effecting the change in density of each species?

2. In a cornfield the population of weeds (that is, all plants except corn) is estimated at $35/m^2$. Half the field is treated with Chemical A, and half with Chemical B. The density of living weeds in the "A" half:

   end of first week.......$22/m^2$
   second week......$13/m^2$
   third week........$8/m^2$
   fourth week.......$6/m^2$
   fifth week........$7/m^2$

   The density of living weeds in the "B" half:

   end of first week.......$32/m^2$
   second week......$26/m^2$
   third week.......$18/m^2$
   fourth week.......7/m2
   fifth week........5/m2

   During the five weeks, what is the net decline of the weed population in each field? Compare the rates of decline in the two halves during the first week after treatment. What population determiner is dominant in this situation?

3. On October 15, 1960, the beginning of the squirrel hunting season for that year, biologists counted 75 grey squirrels in a 30 hectare woods. On December 15, 1960, 42 grey squirrels were counted in the same woods. What was the density of the squirrel population on October 15? On December 15? What determiners must have interacted to affect the density? What determiners must have predominated?

4. On a range of 450 hectares is a total of 1275 jack rabbits. Studies indicate the following rates for this population:

   Mortality..........2225/year
   Emigration.........775/year
   Natality...........3400/year
   Immigration.........150/year

   Is the population increasing? Decreasing? At what rate? Predict the population at the end of four years. What is likely to happen to the population of producers in this area during the four years?

5. In a certain year observations were made of a mule-deer population on a 105 hectare island off the coast of British Columbia.

Number of Does, January 1..............90
Number of Bucks, January 1.............20
Births during year.....................75
Deaths during year.....................50
Number of Deer, December 31...........155

What was the density of the population at the beginning of the year? At the end of the year? What were the effects of immigration and emigration on this population?

ACTIVITY 8: RANDOM SAMPLING: FACT OR FANTASY

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PROBLEM

Determine how the dot density changes from sheet A to sheet B to sheet C.

Use the following approach to the problem:

1. With your eyes closed, toss the random sampling disc onto sheet A. Without moving it, trace its outline onto the sheet of paper.

2. Count the number of dots that are within the circle that you have drawn. Record the information in the chart below.

3. Repeat the above procedure until you have recorded the number of dots in 10 circles. Repeat for sheets B and C.

4. Record the total number of dots in the 10 circles.

5. Determine the average number of dots per circle.

6. Plot the information on the graph below.

7. If the area of the random sampling disc is 12.5 sq. cm., and the area of the sheet is 603 sq. cm., calculate the total number of dots on each of the sheets.

Total Number of Dots:

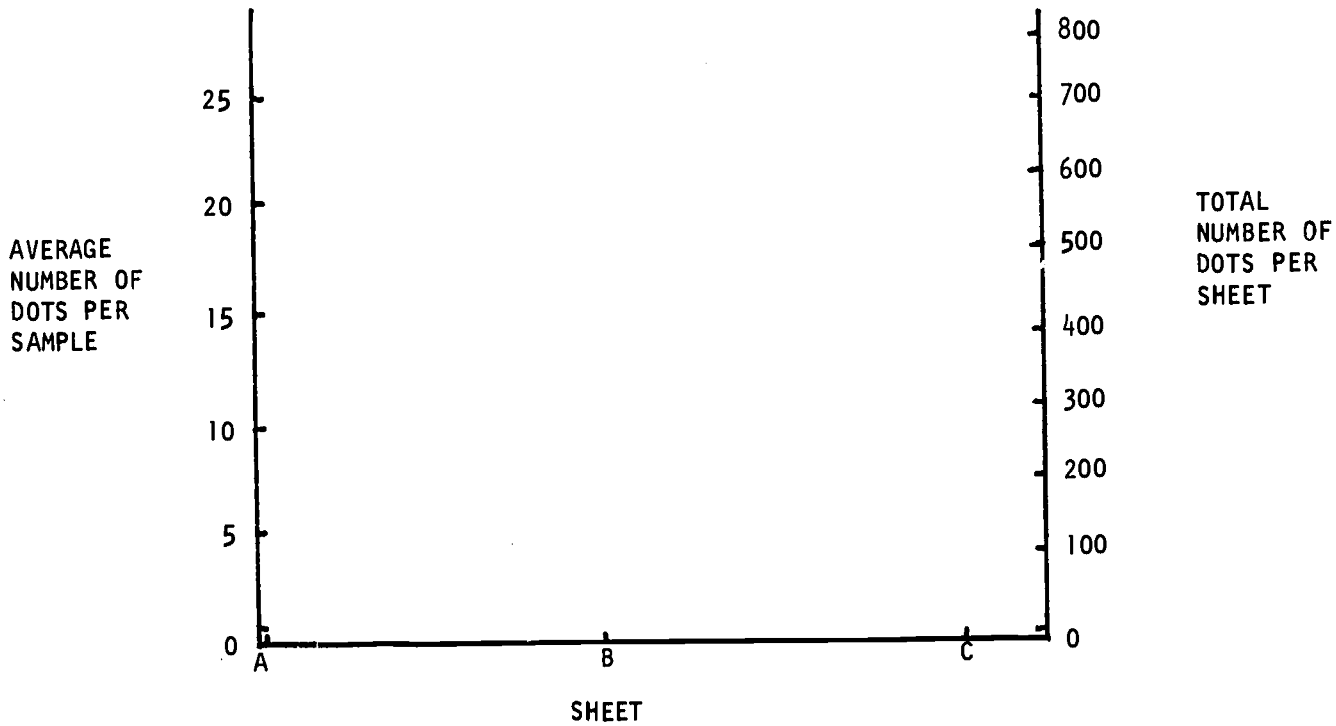
Sheet A: __________

Sheet B: __________

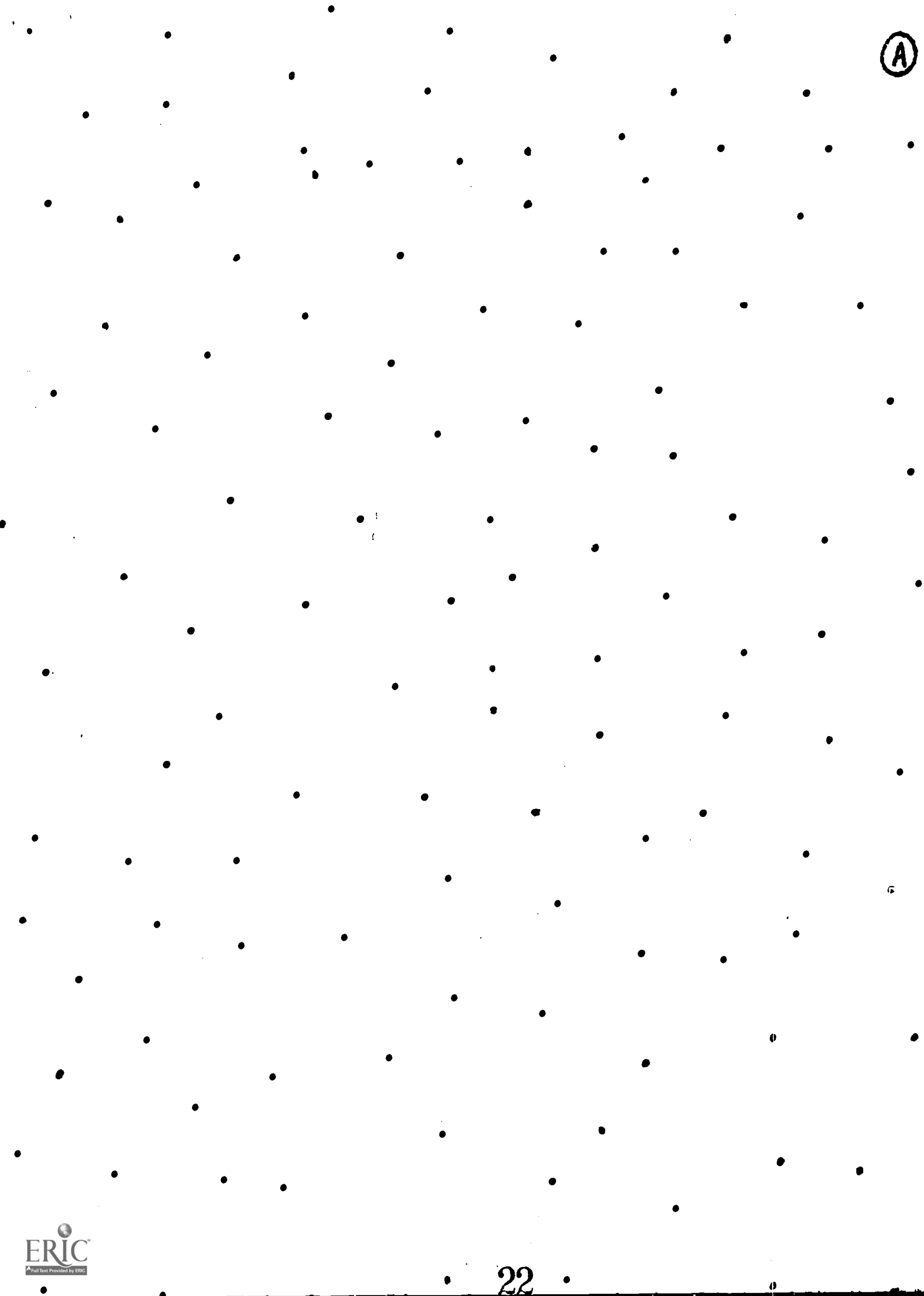
Sheet C: __________

Circle	Number of Dots A	Number of Dots B	Number of Dots C
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
Total			
Aver.			

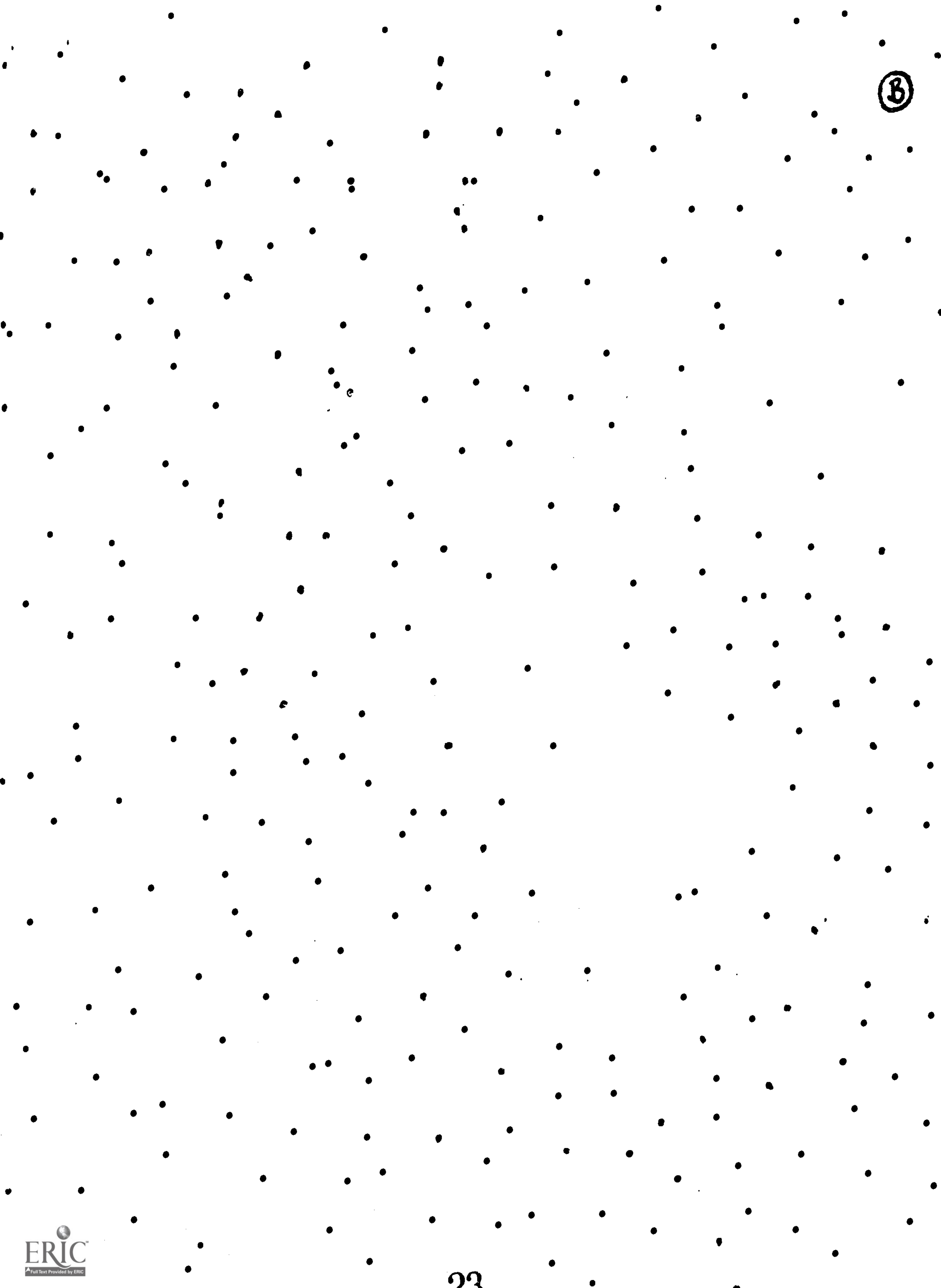
8. Plot the total number of dots on the graph below.



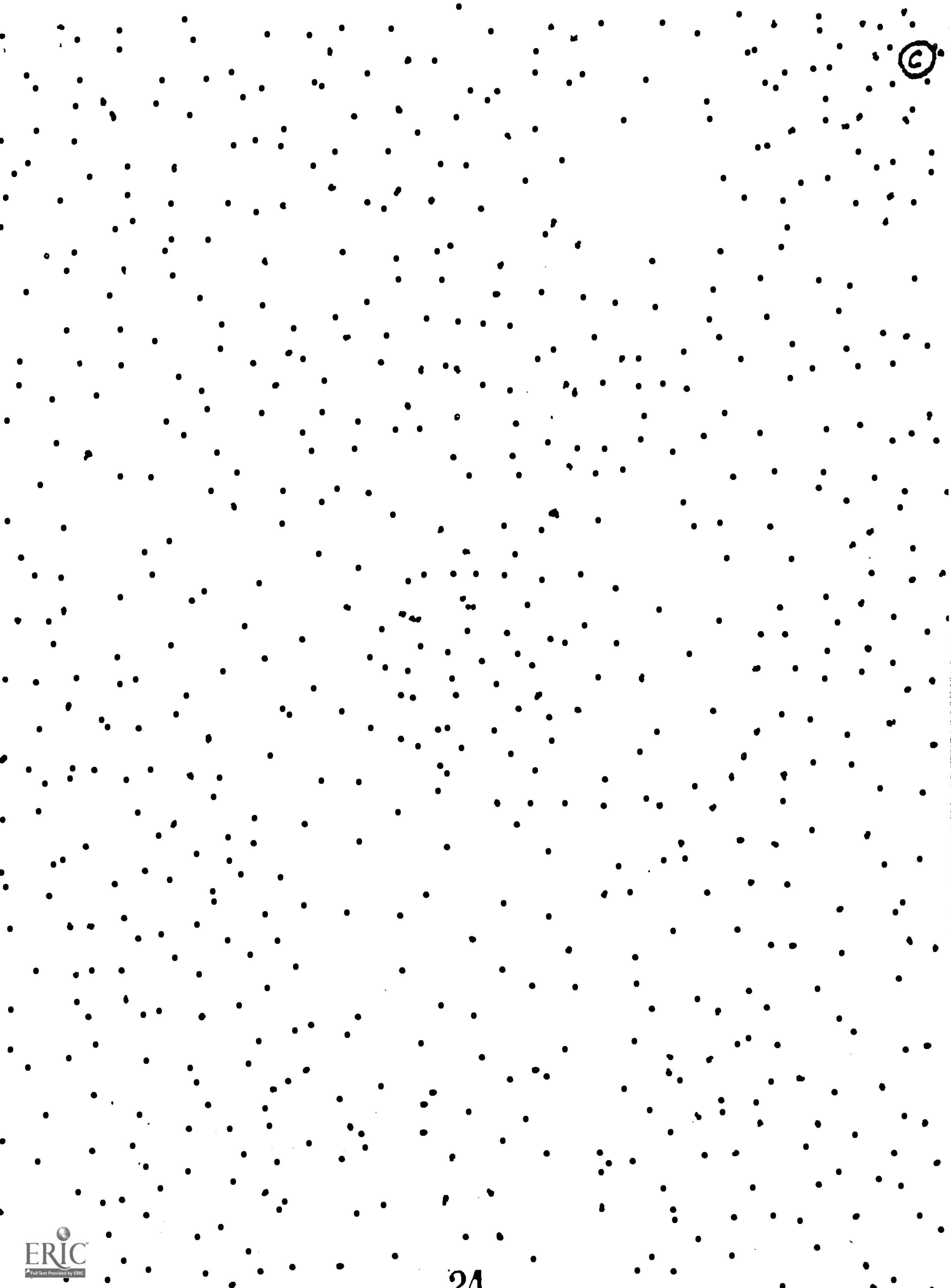
A



B



C



ACTIVITY 9: POPULATION STUDIES I

Set of 3 lessons involved. Proposed as introductory or supplementary.

LESSON 1

Before Period:

Mark out squares 5 m. on a side. Scatter within the square toothpicks of 3 colours: red, yellow, green } 500 of each colour

Colour by dipping in food colouring.

During Period:

Allow 4 students per square. Collect for 5 minutes. Count number of each colour collected.

Discovery:

Some colours are harder to find than others -- relate to pigmentation of animals, plants.

The recovery rate diminishes with time. Difficulty in extrapolating to get total population. Exercise could be repeated under more closely controlled conditions and graphed.

Some people don't know where to stop. Student's results can be affected by larcenous neighbours.

LESSON 2

Before Period:

Select an easily recognized plant (dandelion, plantain). Mark out 10 m. squares with desired plant represented therein. Obtain hoola hoops or substitute frame.

During Period:

Allow 8 students operating in pairs to work in each square for time required. Each pair has 1 hoola hoop (or substitute). This is thrown into the study area and number of representatives of index species within frame are counted. While standing in that 1st area the student makes his next throw. I suggest 5 throws per pair. Calculate on basis of average value, total number of index species in 10 m. square.

Line up all 8 students across 1 end of square and move slowly across counting every plant by touching it (to avoid duplicate counts by neighbours). Compare predicted and actual counts. If there is large discrepancy the fun begins. Which do you place your faith in? Look at Lesson 3.

LESSON 3

The basic problem is that one has no justification for adopting either method as reliable. So:

Before Class:

Place 200 coloured toothpicks in a 10 m. square. Throw frame as before. Ask students to predict total, then move through in a line and count as before. Compare both counts with the actual value.

ACTIVITY 10: FINDING THE RIGHT ENVIRONMENT

Animals are not evenly distributed either, as we have seen. How do they reach the correct environments?

Woodlice, or perhaps you call them slaters, are an example of animals which are unevenly distributed. Where do you find them? Usually they are to be found under the bark of old branches of trees or pieces of trunk. Sometimes they are under stones or among leaf litter. How do they find their way to these places?

Fill a plastic tray with sand which is just moist. In various areas of it make artificial environments like the places where you have found woodlice. Also, include artificial environments like those which did not have woodlice present.

THE WOODLOUSE EXPERIMENT

Release about 30 woodlice in the centre of the sand. Leave them for about 20 minutes or half an hour, and then find out where they all are. Where have they gone? How have they found their way there?

There are many ways in which this experiment could be done. You might do it in the dark, or in the light, to find whether light or some other factor was causing the movements of the woodlice. You could also give them much less choice of environment. It is possible to set up a longer term investigation to study further the movements of the animals.

Set up a tray as before with a base of wet sand, but with more extensive environments which join on to each other.

WOODLOUSE ENVIRONMENTS

Release ten marked woodlice in each area. Woodlice can be marked with cellulose paint, which is quick-drying. Mark one group with a dot at the front, one group with a dot at the back, and one group with a dot in the middle, or use different colours. You can then keep records, in the form of a table, of the woodlice populations of each area.

DATE	AREA 1	AREA 2	AREA 3	AREA 4
12.12.84	10 front dots	10 middle dots	10 back dots	10 no dots
13.12.84	8 front 5 back 5 middle 6 no dots	2 front 5 middle	5 back dots	4 no dots

What are the differences between the areas? The physical environment is probably slightly different in each part of the dish. The climate, that is, the physical conditions, of each slightly different part of an environment is called a micro-climate. It looks as if the woodlice prefer a particular micro-climate. How have they managed to find it?

You can measure some of the differences in micro-climate in your dish; for example, the humidities can be compared. Humidity is a measure of the amount of water vapour in the air.

By using pins, make a number of small cobalt thiocyanate paper flags. This paper shows differences in humidity. It changes from blue in a dry atmosphere to pink in a wet one. Stick these flags into the sand in the various environments, particularly comparing places where the woodlice are found with those where they are not. Be careful that the paper does not actually touch the wood or leaves, as it will take up water from them.

Compare the colours after a little while. Can you detect any differences? Do these differences show any relationship with the distribution of the woodlice?

ACTIVITY 11: NORTHERN ONTARIO WOODLAND

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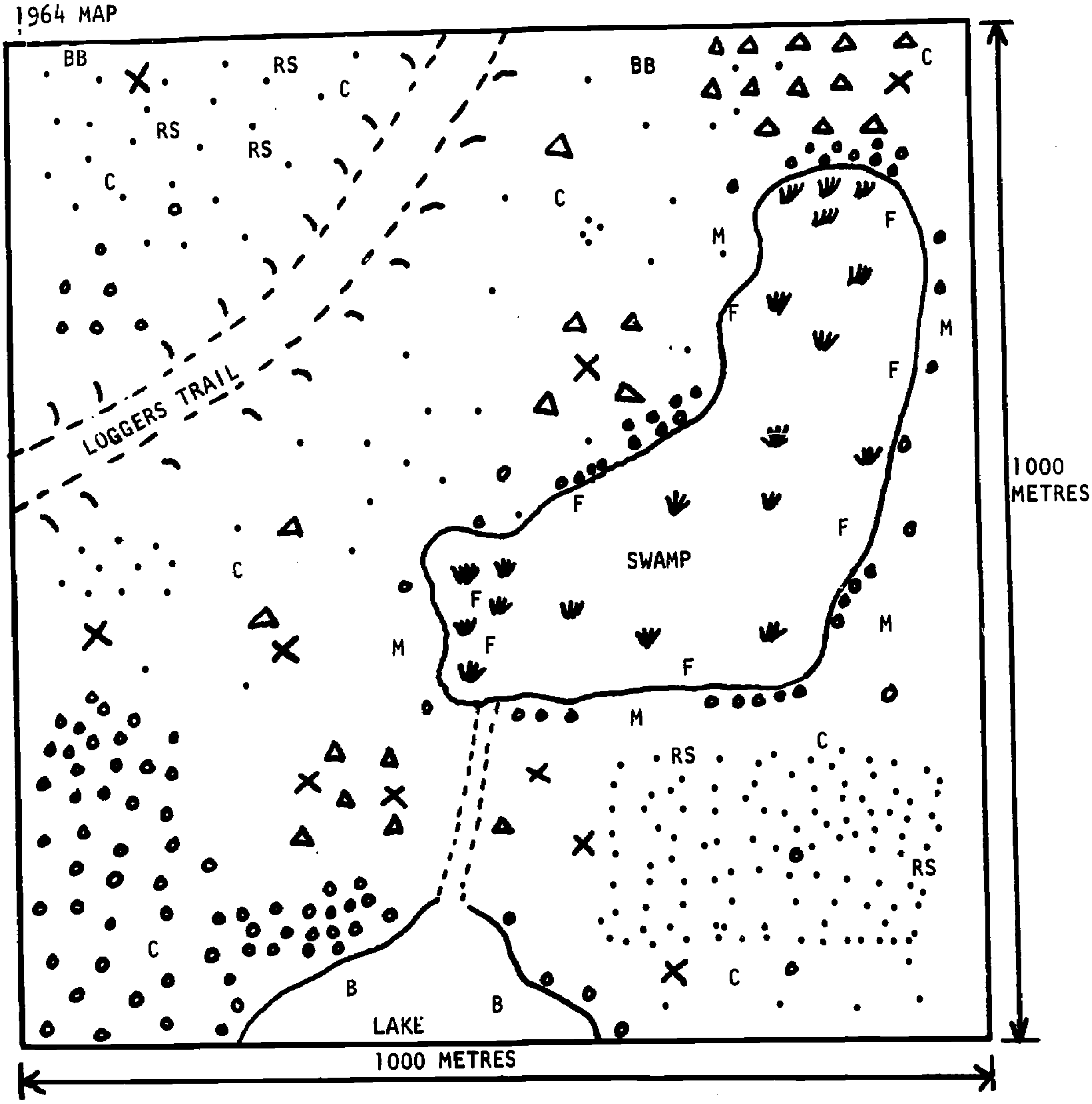
1964 MAP



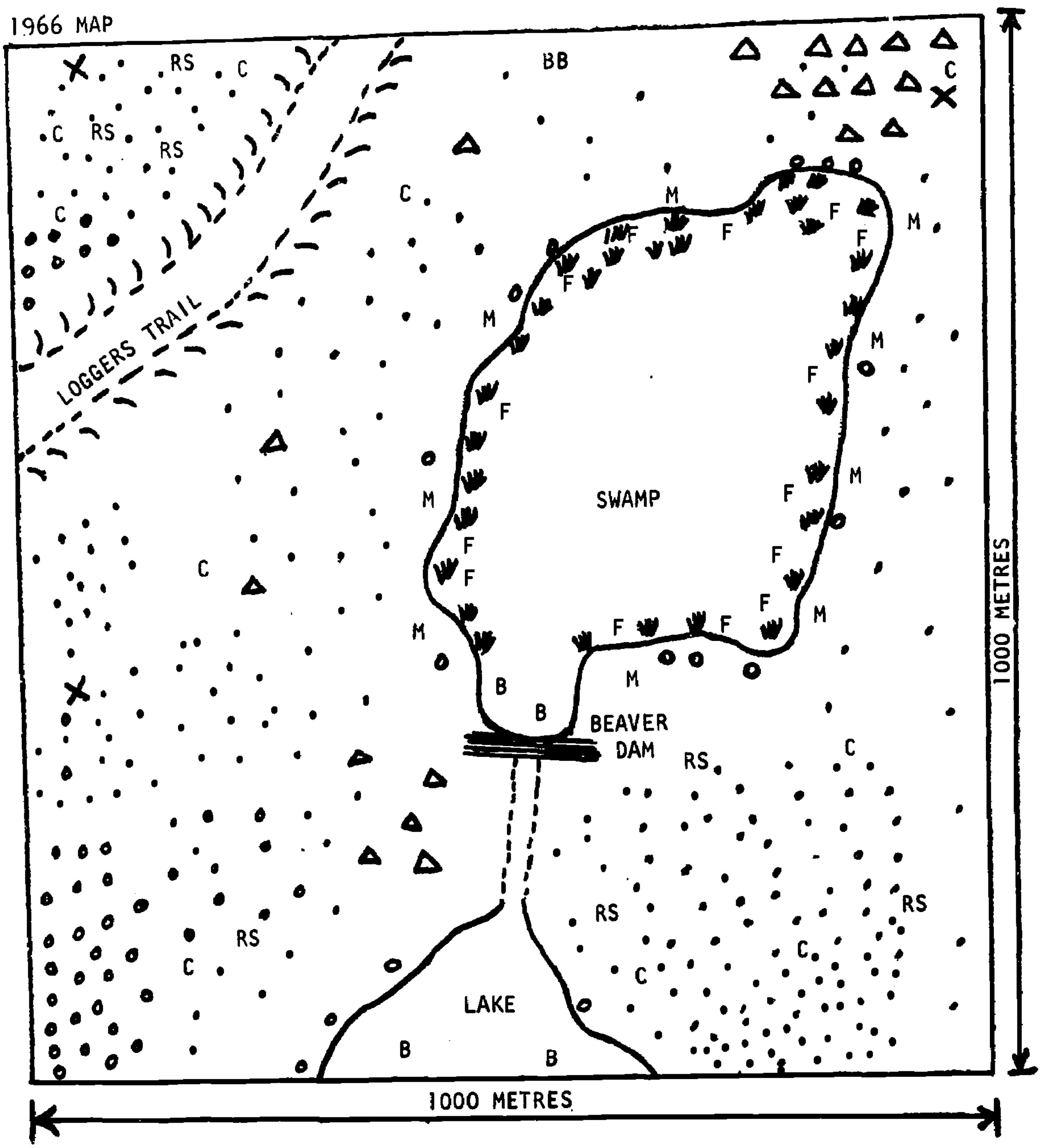
Each symbol represents 5 individuals

1. • • • • • • Sugar Maple Trees
2. ▲ ▲ ▲ ▲ White Pine Trees
3. ● ● ● ● White (Paper) Birch Trees
4. ✕ ✕ ✕ Basswood Trees
5. Ѱ Ѱ Ѱ Bulrushes & Reeds
6.)))) Wild Raspberry

1. F......Frogs
2. RS.....Red Squirrels
3. B......Beavers
4. C......Chipmunks (Ground Squirrel)
5. BB.....Black Bears
6. M......Mosquitoes

1. Calculate the density of each organism on the previous page and list on back.
2. State which animal is most dense and which plant is most dense in this community.
3. State all the relationships which appear to exist between the habitats of certain plants and certain animals.

   eg. Why are bulrushes shown to grow in the swamp and not somewhere else?



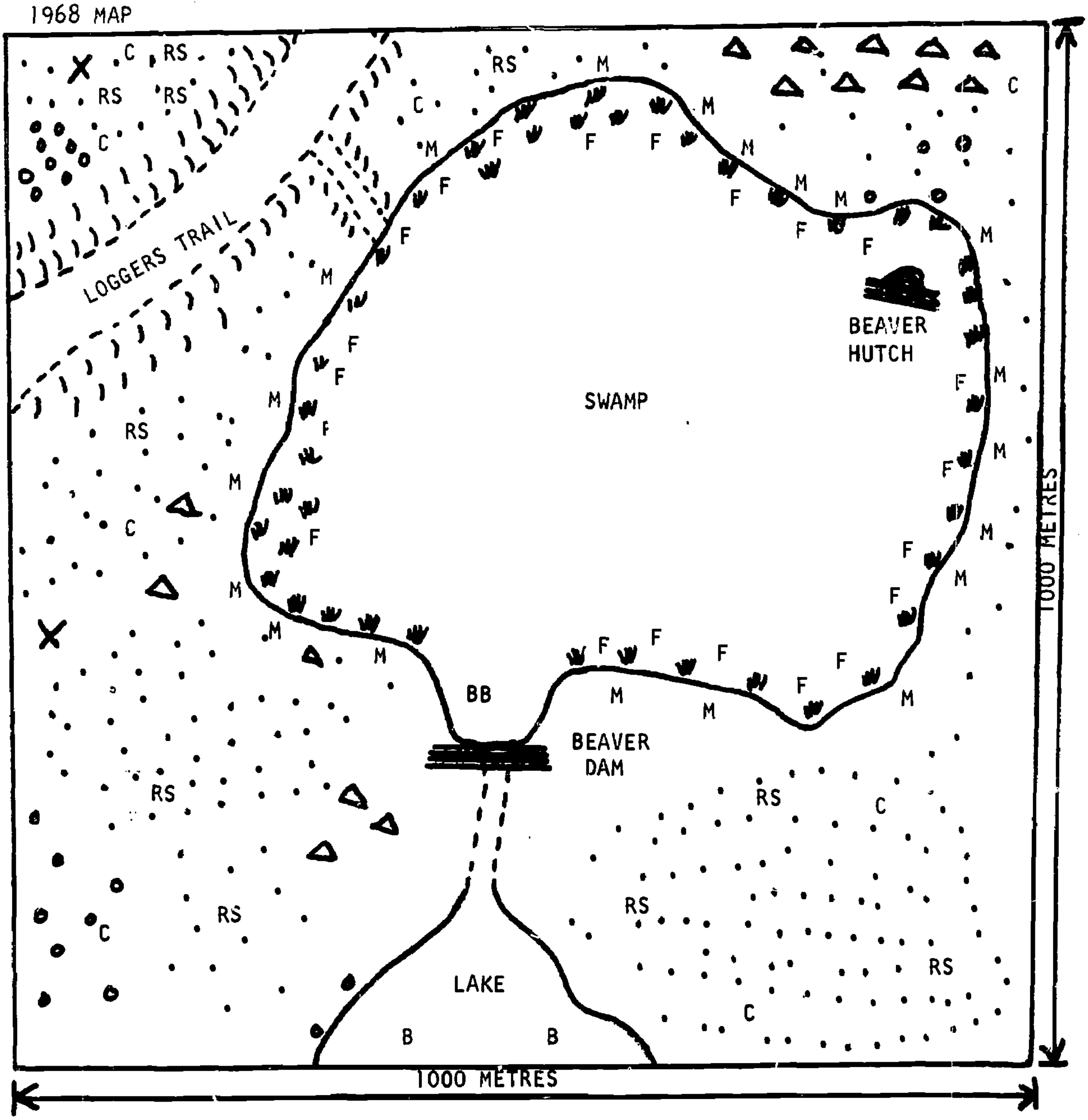
Each symbol represents 5 individuals

1. ......Sugar Maple Trees
2. White Pine Trees
3. White (Paper) Birch Trees
4. Basswood Trees
5. Bulrushes & Reeds
6. Wild Raspberry

1. F........Frogs
2. RS.......Red Squirrels
3. B........Beavers
4. C........Chipmunks (Ground Squirrel)
5. BB.......Black Bears
6. M........Mosquitoes

1. Calculate the density of each organism on the previous page and list on back.
2. State which animal is most dense and which plant is most dense in this community.
3. Compare this with 1964 map. Note changes in density and habitat of each organism. Give reasons for these changes.

1968 MAP



Each symbol represents 5 individuals

1. • • • • • Sugar Maple Trees
2. ▲ ▲ ▲ ▲ White Pine Trees
3. ● ● ● ● White (Paper) Birch Trees
4. × × × × Basswood Trees
5. ψ ψ ψ Bulrushes & Reeds
6.)))) Wild Raspberry

1. F........Frogs
2. RS.......Red Squirrels
3. B........Beavers
4. C........Chipmunks
5. BB.......Black Bears
6. M........Mosquitoes

1. Calculate density of each organism on the previous page and list on back.

2. State which animal is most dense and which plant is most dense.

3. Compare this with 1966 map. Note changes in density and habitat of each organism. Give reasons for these changes.

ACTIVITY 12: 5-CYCLE SEMI-LOG GRAPH PAPER

100,000

50,000

10,000

5,000

1,000

500

100

50

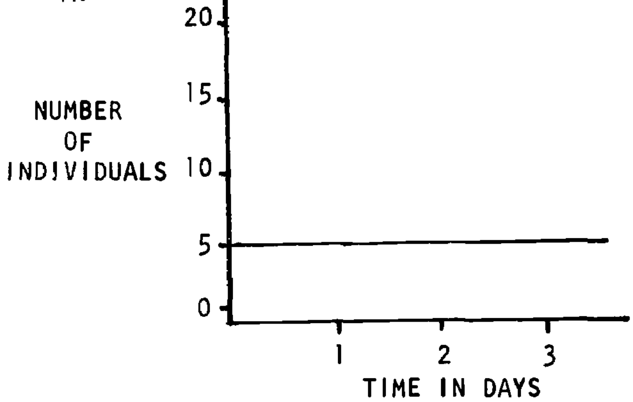
10

5

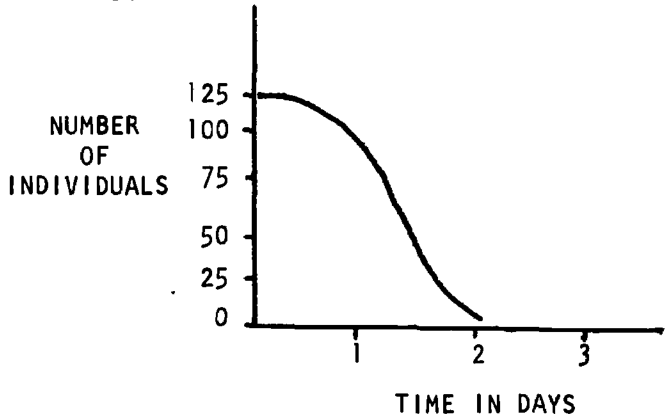
ACTIVITY 13: POPULATION INTERACTIONS

The following questions deal with a community of water plants, goldfish and fairy shrimp.

A.



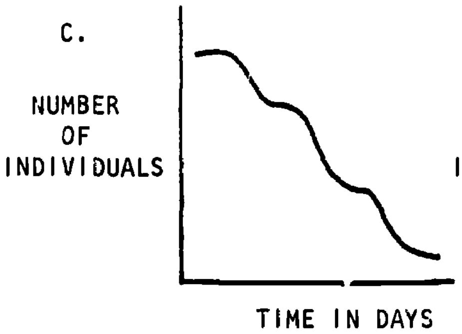
B.



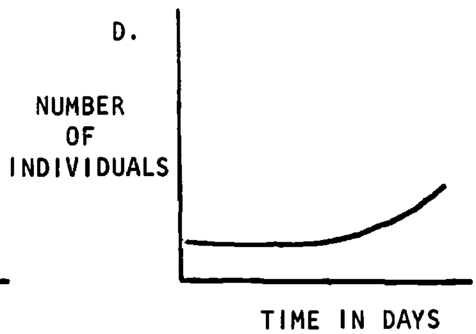
1. Which of the above graphs (A or B) would best represent the goldfish portion of the community? Why?

2. Which of the above graphs (A or B) would best represent the fairy shrimp portion of the community? Why?

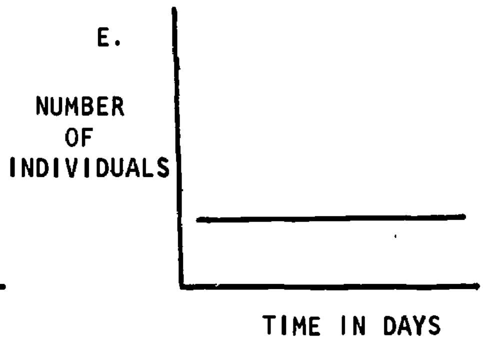
C.



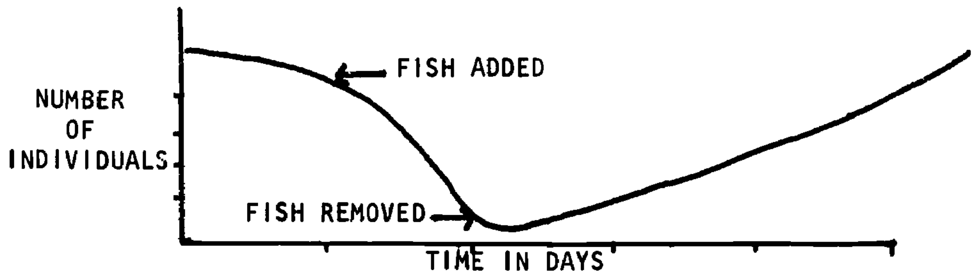
D.



E.



3. Which of the above graphs (C, D or E) would most likely represent what would happen to the fairy shrimp population after removal of the goldfish? Why?



THUS: The fairy shrimp population changed in numbers because of the effect of the fish population on it.

ACTIVITY 14: POPULATION STUDIES II

OUTLINE OF WORK

1. BSCS Investigation 2.1: Answer all the questions on Page 44. Also the further investigations, Nos. 1, 2 and 3.

2. BSCS Investigation 2.2: Yeast population study modified as outlined below.

3. BSCS Investigation 2.3: Answer all the questions, Nos. 1 - 19. Most require only short answers.

4. Long term population studies on supplies, outlined below.

5. Long term population studies on gerbils.

YEAST POPULATION

It is intended that you work on 1 and 3 -- graphing of population changes, whilst at the same time working on Nos. 2, 4 and 5. No. 2, the yeast population, requires that a "count" be made every day for a ten-day period. This will involve some of your group each day, leaving the others to work on the graphs. A rota can be arranged for each group so that all members of the group will undertake a yeast count. Each day each flask will be "counted" by two members of the group. The procedure is as follows:

GROWING THE POPULATION

You will be provided with 250 ml. flasks containing 200 ml. culture medium.

Inoculate the medium with 8 grains of dry yeast. Stir with a glass rod to disperse the yeast cells and shake the flask.

Form a tight, compact stopper for the flasks from cotton wool.

Write your group identification, the intitals of the leader of your group, and the number "1" on a piece of tape and attach to the flask. The flasks can be stored in the bench cupboard.

The second flask, number "2", will be inoculated on Monday.

The use of these two flasks will allow each group to obtain results for a complete ten-day period as indicated below.

DAY NO.	CLASS NO. 1	2
1	Thursday	Monday
2	Friday	Tuesday
3	----	Wednesday
4	----	Thursday
5	Monday	Friday
6	Tuesday	----
7	Wednesday	----
8	Thursday	Monday
9	Friday	Tuesday
10	----	Wednesday

COUNTING THE POPULATION

Shake the culture flasks to disperse the yeast cells uniformly. Using an eye dropper pipette, transfer 2 drops of the culture onto a clean slide and cover with a clean cover slip.

Do not press down on the cover slip. Make sure you use the same pipette by attaching it to the flask by means of an elastic band. Count the number of individual cells in 5 different high power fields selected as shown:

Each cell in a clump is to be counted as a separate cell and any "bud" is also counted as a separate cell.

Two members of the group will each make a count of 5 fields from each flask. Record the counts in the accompanying table.

DILUTION TECHNIQUE

If the fields are too crowded for easy counting, a dilution must be made. For example, to obtain a x10 dilution, transfer 1 ml. of the culture, after shaking, to a test tube, and add 9 ml. of water and mix thoroughly. Attempt to make a count. If still too crowded, transfer 1 ml. of the x10 dilution to another test tube and add 9 ml. of water, to give a x100 dilution. If necessary, repeat the procedure to obtain a x1000 dilution. (Read BSCS, Page 54-56)

PRESENTATION OF DATA OBTAINED

1. Result sheet for your own group.

2. Record averages from each group and work out a clan average for each day.

3. Prepare graphs as follows: graphs for your own flasks 1 and 2, graphs for the clan averages.

An idea of the likely results for the "missing" days for flask 1 can be obtained from flask 2 results, and vice versa.

ACTIVITY 15: POPULATION CHANGES IN A CLOSED SYSTEM

For this lab we will be using a population of fruit flies (scientific name -- Drosophila melanogaster). You will start off with a pair of flies -- one male and one female. The population will be closed; that is, you must prevent any flies from leaving or entering the population. To do this, you will grow (culture) the flies in a fly-proof bottle. You will have to provide the two original flies and all their offspring with a certain set of conditions to allow them to stay alive and to breed. Name four conditions which must be supplied to a living thing to permit it to stay alive and breed.

1. ______________________________ 2. ______________________________

3. ______________________________ 4. ______________________________

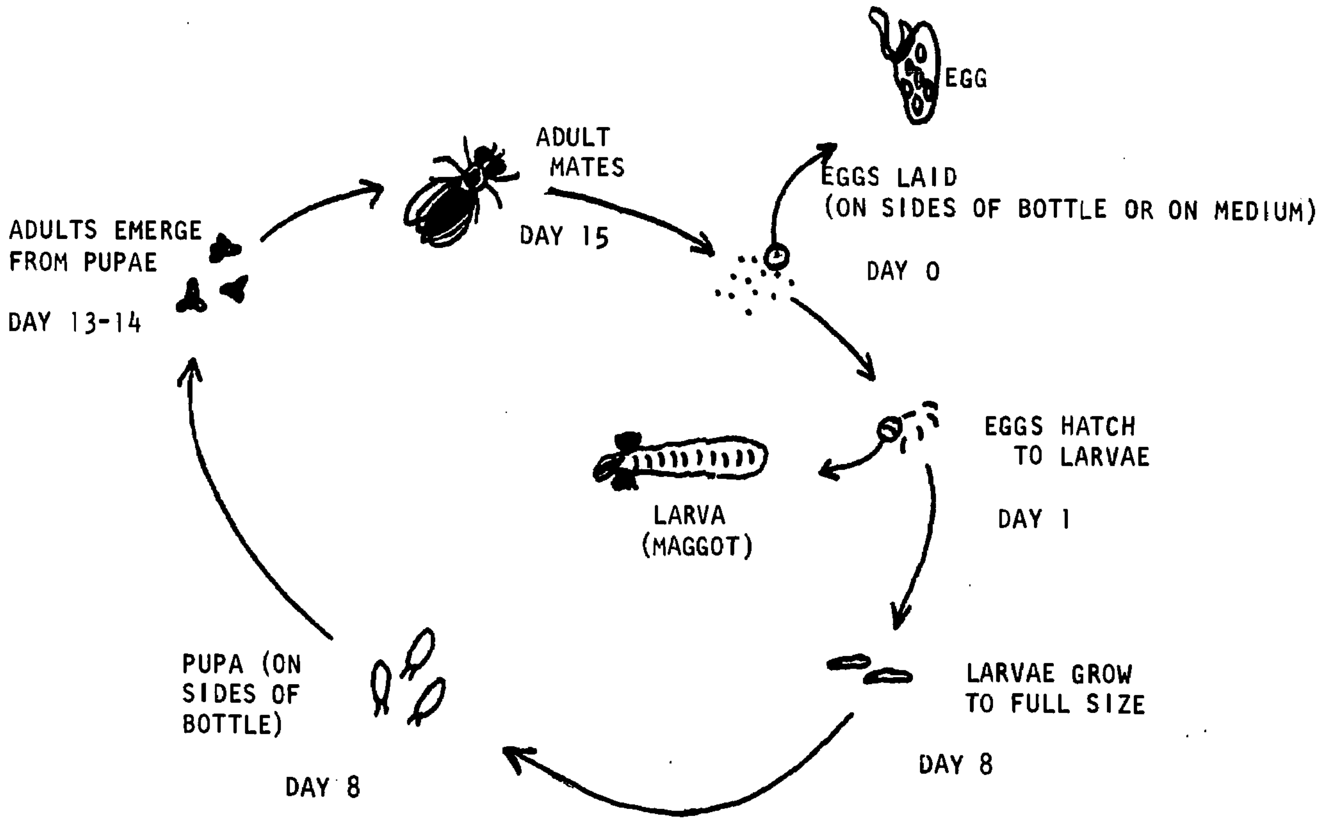
One of these conditions is a certain amount of space. The bottle in which the flies will be living is going to supply the space and limit the population to living entirely within the space.

A second condition is air. This is provided for by a small hole in the lid of the bottle. To prevent the flies from escaping through this hole, the inside of the lid of the bottle is lined with a disc cut from paper towels. The pores in the paper towel do not allow the flies out, but it does permit free circulation of air.

Food and water are another consideration, and there is some problem here because the adult flies do not have quite the same food requirements as the larvae (or maggots). The adults prefer yeast and the larvae will eat vegetable matter such as decaying fruit or vegetables. Fortunately, the problem can be solved by mixing up some corn syrup, and cornmeal in water and then making this mixture thick and solid (so it won't run all over if the bottle tips, and won't drown the adults if they land on it) by adding agar (a substance like jello) that thickens the food. If dry yeast is sprinkled over the surface, the yeast can grow and reproduce on this substance (called the media) and so supply food for the flies. The larvae will eat the yeast as well as the cornmeal.

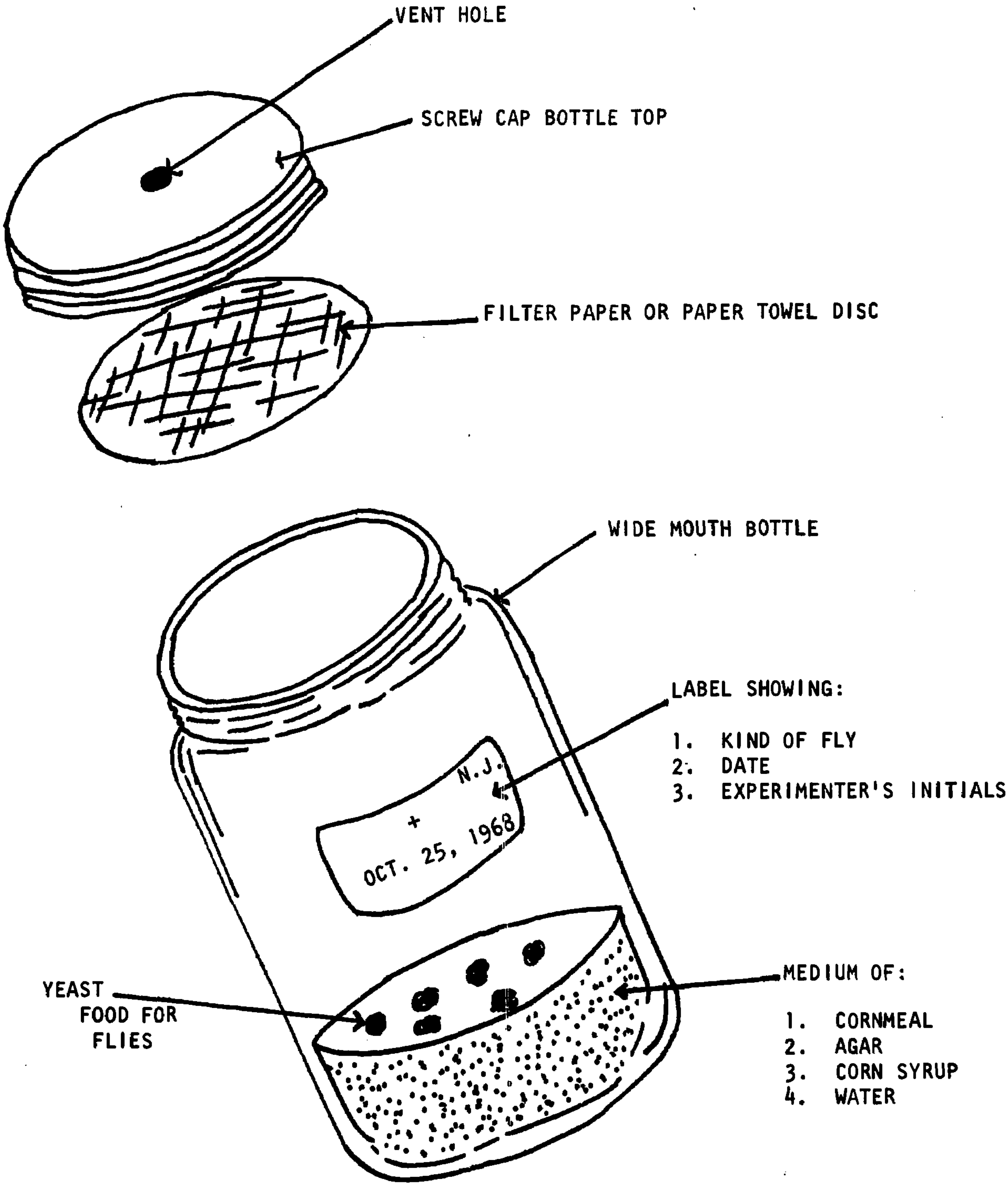
A fourth requirement is a proper temperature. The flies do not breed well or grow very fast at a temperature below 60°F. The warmer the flies are, the faster the eggs hatch and the faster the flies grow. However, if the temperature goes too high (above 77°F) the eggs will not hatch and the population will stop growing.

The life cycle of the fruit fly is outlined on the next page. Times given are for a constant temperature of 68°F.



If you look carefully at the diagram, you will see that the next generation of fruit flies is on its way 15 days after the generation before it; that is, the life cycle is complete in 15 days.

CULTURING THE FRUIT FLY (Drosophila melanogaster)



HOW TO MAKE A POPULATION COUNT

To begin with, it is hopeless to attempt to count the flies without first finding a means to stop them from moving around. You cannot count them by merely looking at them through the glass walls of the bottle. The flies have to be removed from the bottle for counting, but you must <u>never</u> take the top off a fly culture bottle unless the flies are unconscious.

Ether is used to knock the flies unconscious but since ether can be fatal in overdoses to fruit flies (and humans) you must be very careful. The key to success is to be patient. The operation goes like this:

1. Obtain a small container of ether and an eye dropper.

2. Clear away all unnecessary material from the work area.

3. Have ready a sheet of white paper, a data sheet, a pen or pencil, a small soft brush, and a new paper towel disc to fit the cap of the bottle, and a paper towel cut or ripped 1" x 2".

4. Fill the eye dropper with ether, and empty the dropper of ether into the vent hole in the cap. (Work quickly with the dropper of ether because it does not stay in the dropper too well since the ether vapours fill the rubber bulb and push the liquid out the other end all over everything.)

5. Put your finger over the vent hole to stop the ether vapours from escaping.

6. Watch the action of the flies in the bottle carefully. As soon as all the flies stop moving (in about 15 to 30 seconds), remove the cap from the bottle and shake (<u>gently</u>) the flies onto the sheet of white paper. Be gentle here because you might break the medium away from the bottom of the bottle and have it fall out on the flies. Do not worry about flies that seem to be stuck in the bottle because they are dead and should not be counted anyway.

7. You now have about 120 seconds (2 minutes) to count the flies and get them back into the bottle before they wake up. Spread the flies out along one side of the paper (let's say the top) and using the soft brush, push each fly, one at a time, into a little pile close to the centre of the paper, counting each fly as you push it.

8. As soon as all flies are counted, record the day and number of flies on your data sheet.

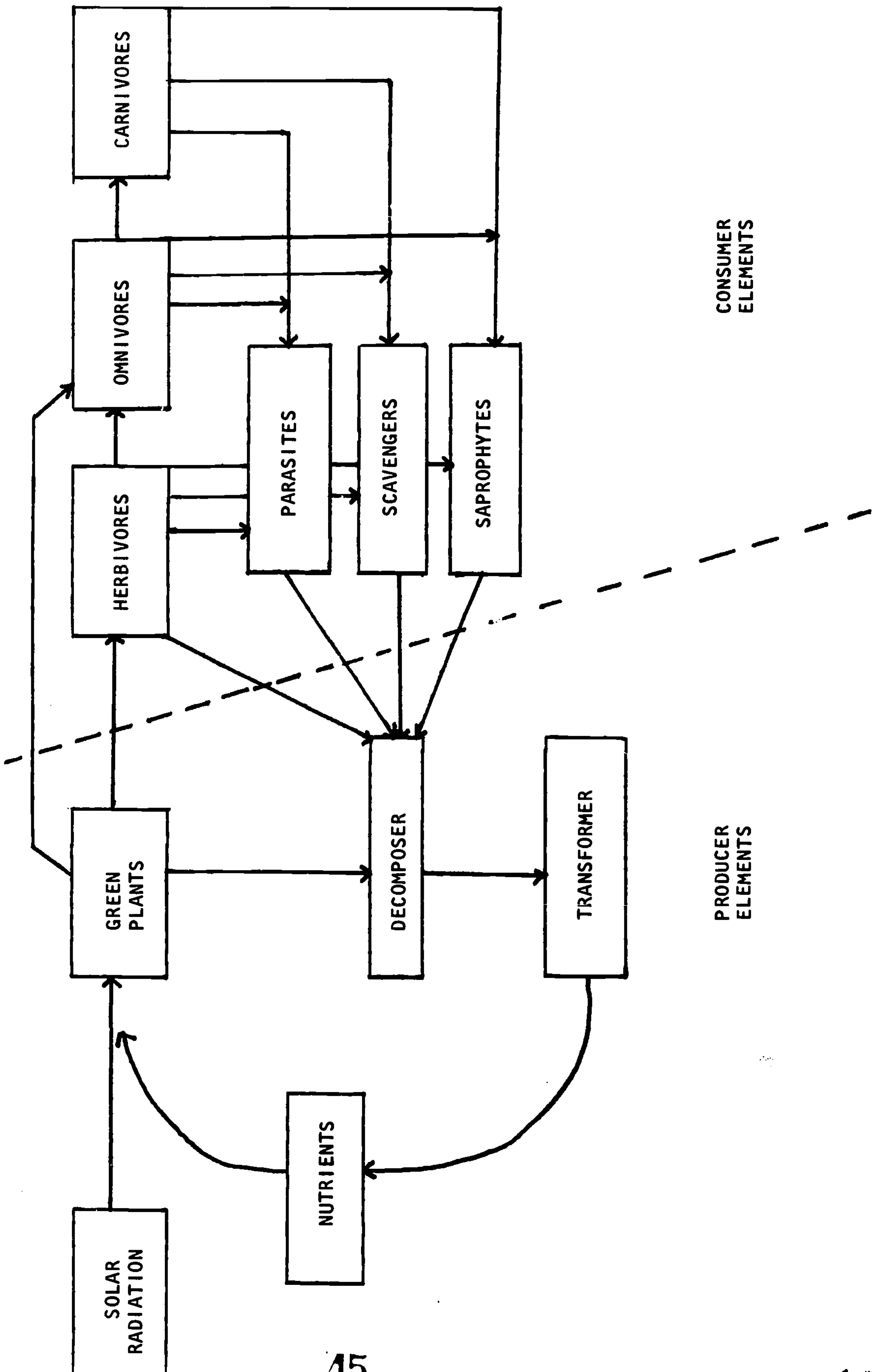
9. Transfer the pile of flies to the piece of paper towel previously cut to 1" x 2". Lay the bottle on its side, and place the towel in the bottle. LEAVE THE BOTTLE ON ITS SIDE AND MAKE SURE ALL THE FLIES STAY ON THE TOWEL. This is to prevent an unconscious fly from getting stuck to and drowning in the wet food medium.

10. Remove the old paper towel disc from the lid of the bottle and put the new disc in place. Don't forget this because the old one might still have ether on it, and the additional fumes will kill all your flies. Replace the cap on the bottle without spilling any flies off the towel. Leave the bottle on its side until all (or most) of the flies have recovered.

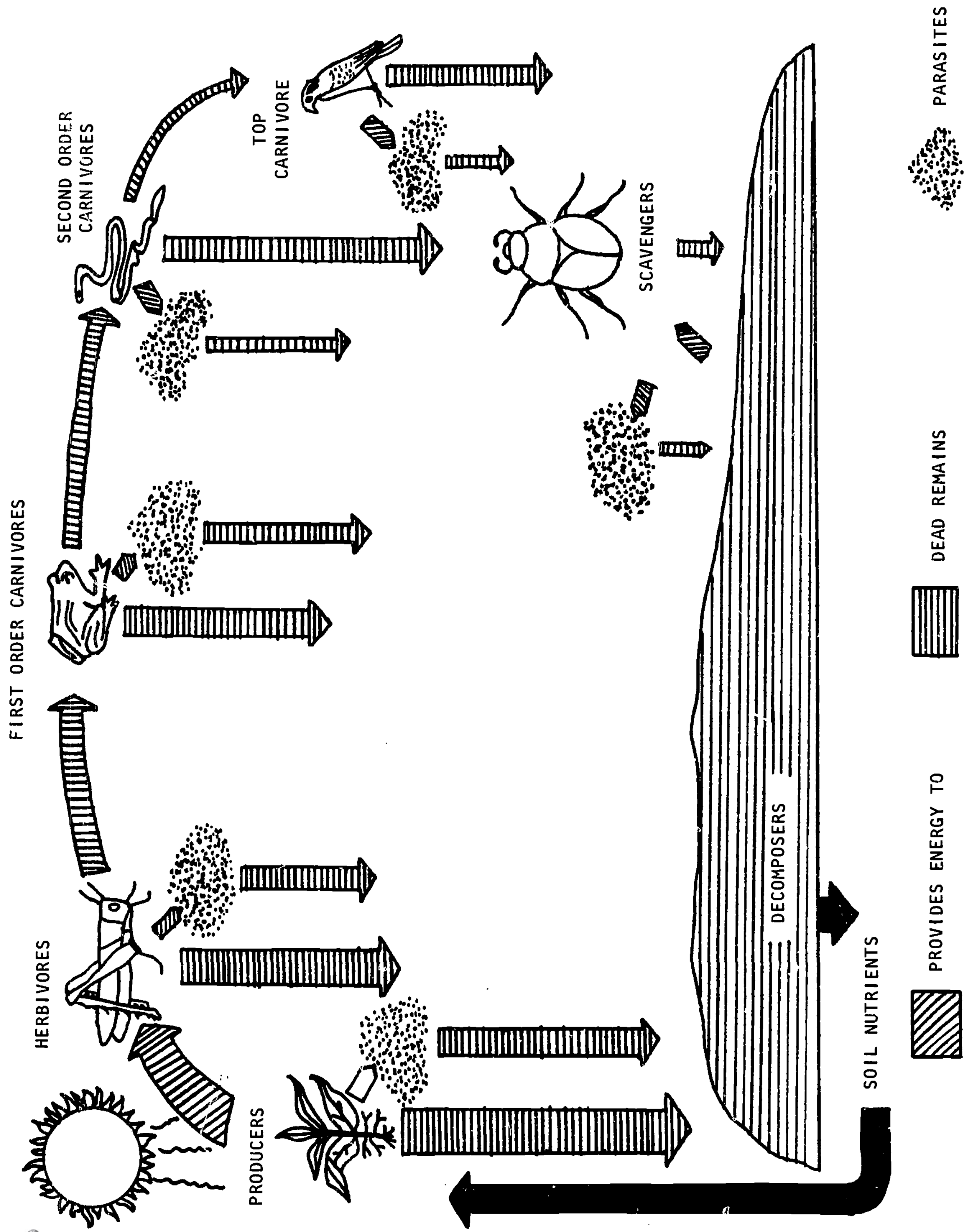
11. Make any additional observations that are required, such as the dryness (or wetness) of the medium, the condition of the sides of the bottle and so on, then return the bottle to its storage place.

ACTIVITY 16: THE "PRODUCER-CONSUMER" SYSTEM

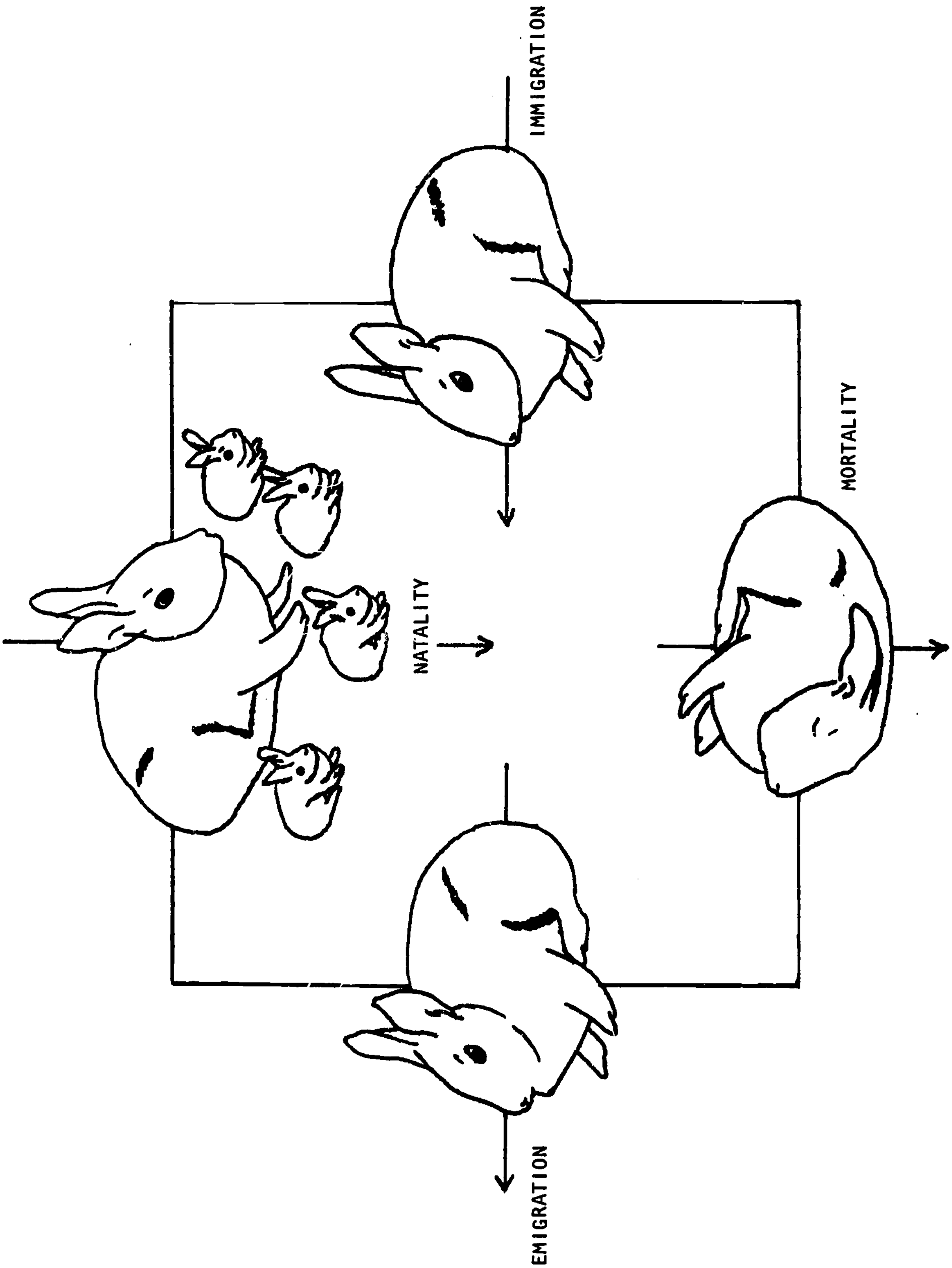
IN STEADY STATE



ACTIVITY 17: NICHES OF A BIOTIC COMMUNITY

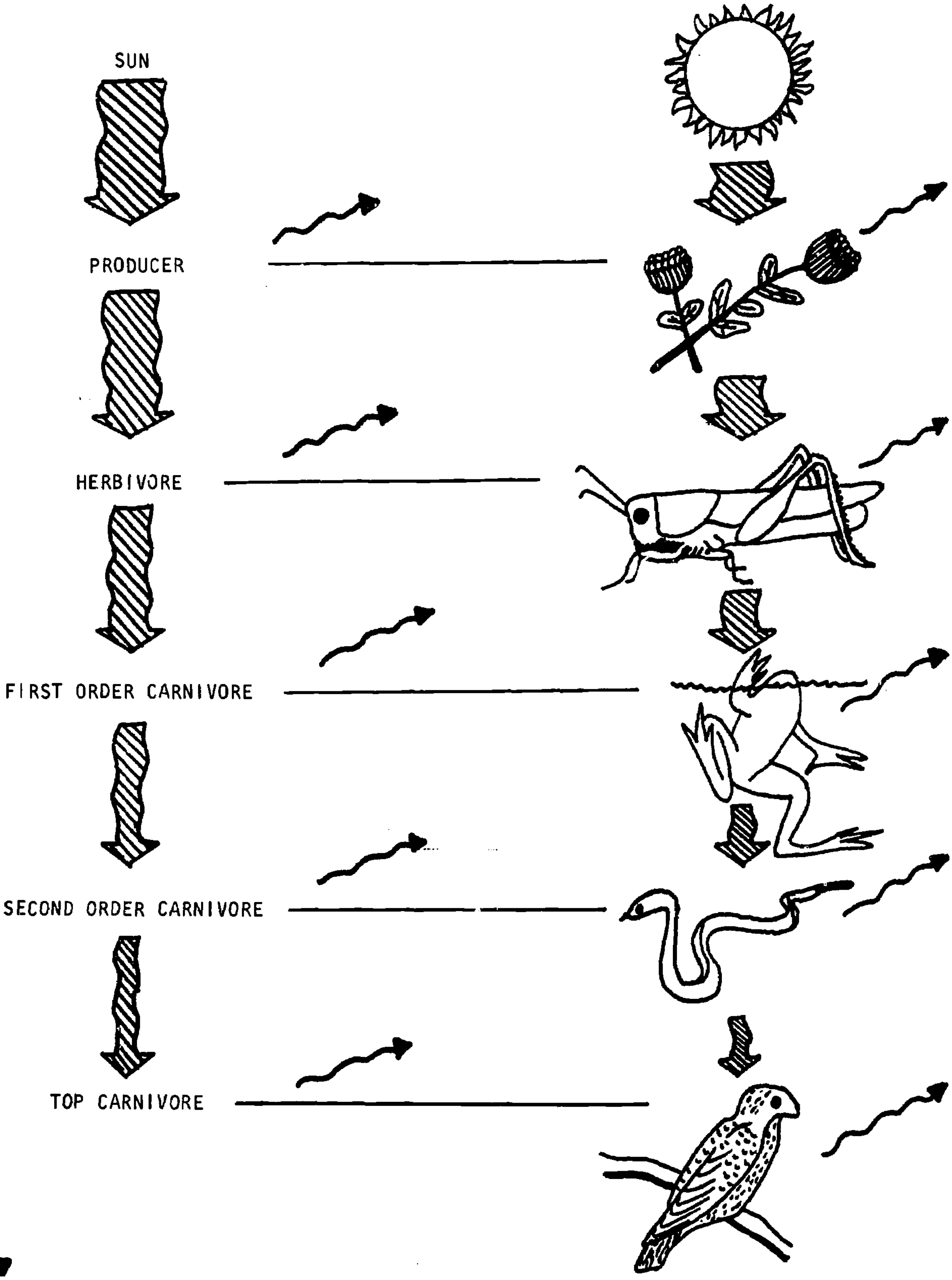


ACTIVITY 18: DETERMINERS OF POPULATION DENSITY



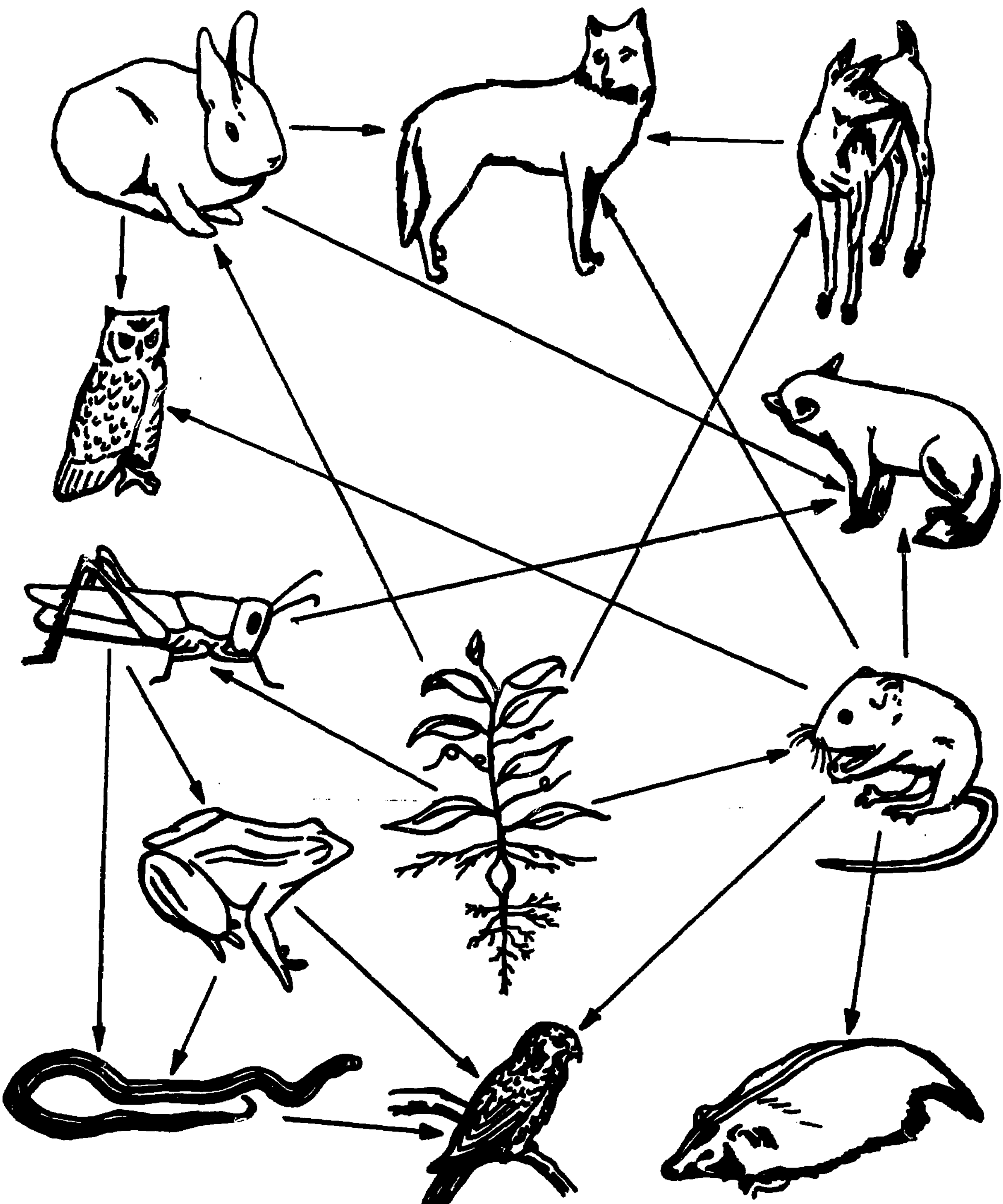
NATALITY -- IMMIGRATION .... INCREASE POPULATION DENSITY
MORTALITY -- EMIGRATION .... DECREASE POPULATION DENSITY

ACTIVITY 19: AN ENERGY CHAIN



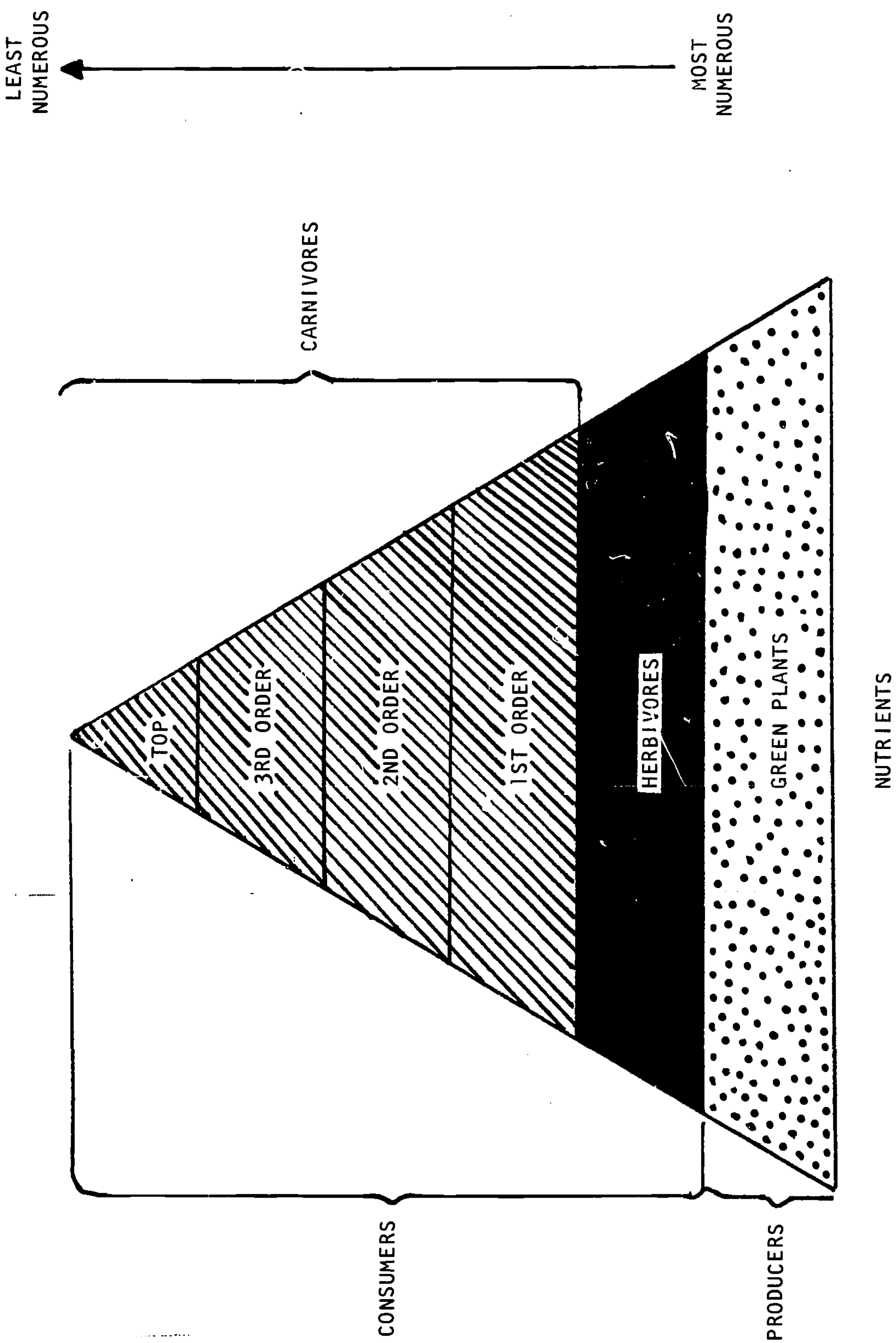
= ENERGY -- LOST AT EACH LEVEL, PRIMARily AS HEAT

ACTIVITY 20: A POSSIBLE ENERGY WEB



→ = EATEN BY

ACTIVITY 21: PYRAMID OF NUMBERS



2. 16 MM. FILMS

   1. Population Ecology

   2. Distribution of Plants & Animals

3. FILMSTRIPS

   1. Populations & Food, 1521 } F.O.M.

   2. Biological Communities, 1522 } F.O.M.

   3. Physical Environment } McGraw-Hill

   4. Ecological Succession } McGraw-Hill

   5. Forest as a Community } McGraw-Hill